

LAWRENCE LIVERMORE REPORT

A weekly collection of scientific and technological achievements from Lawrence Livermore National Laboratory: July 7-14, 2008.

New research distinguishes mine collapses from seismic activity



Scientists have found a way to distinguish seismic waves.

Researchers have devised a technology that can distinguish mine collapses from other seismic activity.

Using the large seismic disturbance associated with a Utah mine collapse last August, Lawrence Livermore National Laboratory scientists and colleagues from the Berkeley Seismological Laboratory at the University of California, Berkeley applied a method developed to detect underground nuclear weapons tests to quickly examine the seismic recordings of the event, and determine whether that source was most likely from a collapse.

The collapse of the Crandall Canyon mine in Utah registered as a 3.9 magnitude event. Using a full seismic waveform matching technique, the team of researchers have devised a method to better differentiate underground nuclear tests from earthquakes, mine collapses, mine blasts and other events that generate seismic waves.

The new research appears in the July 11 edition of the journal *Science*. For more information, see

https://publicaffairs.llnl.gov/news/news_releases/2008/NR-08-07-03.html

Monitoring nuclear weapons from the inside



As nuclear weapons' components age, ensuring the reliability of the stockpile has become an increasingly complicated and costly challenge.

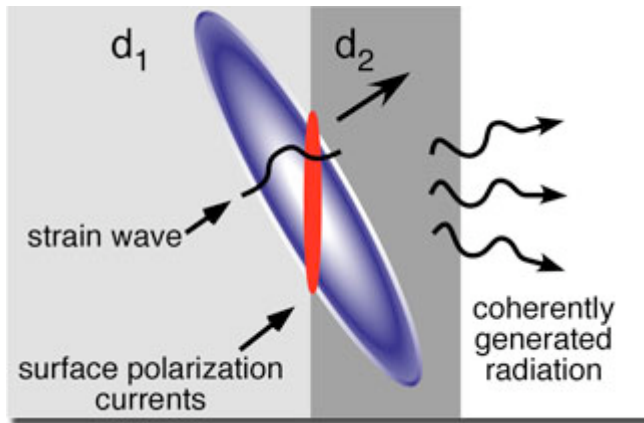
To help answer this challenge, Livermore scientists are developing tiny, rugged sensors that could be embedded in every nuclear weapon. Embedded sensors, compatible with warhead materials, could make possible for the first time “persistent surveillance” -- continuous monitoring of the state of health for every weapon and practically instantaneous detection of anomalies.

Once in place, an array of different sensors could signal the presence of unwanted gases, record stresses incurred as a warhead is moved and detect microscopic cracks and voids.

“If we could assess every weapon in real time, we would immediately know which warheads need to be pulled apart, and that would drive down costs,” says Lawrence Livermore chemist Lou Terminello, who leads the Laboratory’s materials program. Bruce Goodwin, principal associate director for Weapons and Complex Integration, adds, “Embedded sensors have the potential for a huge payoff in costs and manpower. They will give us stronger confidence in the stockpile.”

For more information, see the current edition of the Lab’s *Science & Technology Review* at <https://www.llnl.gov/str/JulAug08/trebes.html>

Visualizing atomic-scale acoustic waves in nanostructures



Electromagnetic radiation is produced when an acoustic wave (purple) generates electric currents (red) as it propagates past an interface between two piezoelectric materials.

Acoustic waves play many everyday roles -- from communication between people to ultrasound imaging. Now the highest frequency acoustic waves in materials, with nearly atomic-scale wavelengths, promise to be useful probes of nanostructures.

However, detecting them isn't so easy.

Enter Laboratory scientists, who discovered a new physical phenomenon that enables them to see high-frequency waves by combining molecular dynamics simulations of shock waves with an experimental diagnostic, terahertz (THz) radiation.

The Livermore scientists performed computer simulations of the highest frequency acoustic waves forming spontaneously at the front of shock waves or generated by sub-picosecond pulse-length lasers. They discovered that, under some circumstances, when such a wave crosses an interface between two materials, tiny electric currents are generated at the interface. These currents produce electromagnetic radiation of THz frequencies that can be detected a few millimeters away from the interface.

“This kind of diagnostic promises to provide new information about shocked materials like the dynamics of crystals pushed to ultra-high strain rates,” said Evan Reed, one of the scientists on the project. Reed also is a lead author of a paper on the research, which appears in the July 7 edition of the journal *Physical Review Letters*.

For more information, see

<http://www.sciencedaily.com/releases/2008/07/080703160751.htm>

Winners cash in on science activities



During a “Fun with Science” presentation, the Lab’s Mike Revelli guides a student volunteer as he lowers a vinyl glove into liquid nitrogen to demonstrate how material properties can change with temperature.

Fifteen students in grades one through six who participated in an award-winning family reading program recently participated in hands-on science lessons through Lawrence Livermore's Discovery Center.

The reading program, Book Buck\$, is sponsored by the Bay Area News Group, which publishes the *Oakland Tribune* and *Contra Costa Times*, among other publications. The program brings newspapers to local classrooms in support of reading activities. This is the second year the Lab has partnered with the program.

The students, who came from Livermore, Fremont, Alameda and Union City, participated in hands-on activities and the Lab's award-winning "Fun with Science" program as part of a reward for exceeding their Book Buck\$ reading assignments.

Photo of the week



Chemical super sleuths -- Postdoctoral fellow and physicist Kristl Adams (left) and staff physicist Julie Herberg are shown detecting chemical signatures using a portable nuclear magnetic resonance (NMR) spectrometer for detecting chemicals. The instrument, developed by the Lab's Center for National Security Applications of Magnetic Resonance, is a project of the Global Security Principal Directorate. The spectrometer has been shrunk in size from about one-quarter of a room to approximately the size of a briefcase.

Photographer: Jacqueline McBride/LLNL

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